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Technical Report ARAED-CR-90008

RE-EXAMINE LIQUID PROPELLANT NITROMETHANE HAZARD CLASSIFICATION PARAMETERS AND ADDRESS THE HAZARDS CLASSIFICATION OF VARIOUS SLURRY MIXTURES

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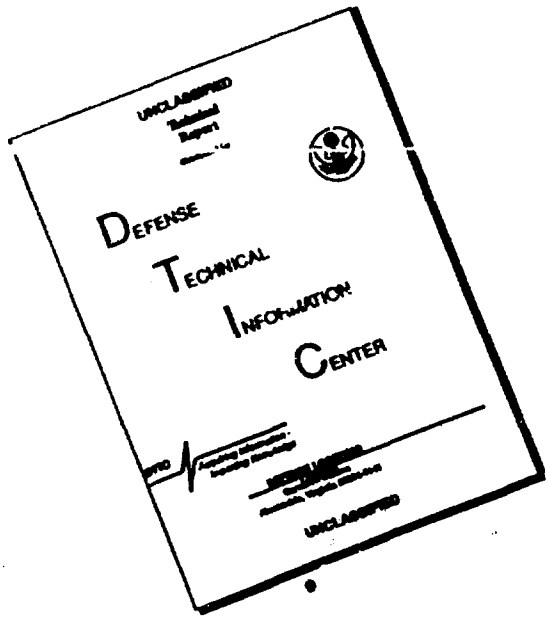

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19. ABSTRACT (CONTINUE ON REVERSE IF NECESSARY AND IDENTIFY BY BLOCK NUMBER)

Nitromethane is a potential candidate for the main energetic material in the U.S. Army Tactical Explosive System (TEXS). Storage of nitromethane in a general purpose warehouse is advantageous. The goal of this program was to examine the regulation concerning hazard classification, transportation, and storage of liquid propellant nitromethane. Agencies reviewed included United Nations, U.S. Department of Defense, U.S. Department of Transportation, and the Occupational Safety and Health Administration of the Department of Labor. At present the United Nations, the U.S. Department of Transportation, and the Occupational Safety and Health Administration classify nitromethane as a flammable liquid. The Department of Defense classifies nitromethane as a mass detonating explosive. The Department of Defense classification does not permit storage in general warehouses. To store nitromethane in a general purpose warehouse, the notromethane would have to be reclassified or the user would have to obtain a waiver. Waivers are difficult to obtain and are only valid for limited time periods.

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INTRODUCTION

Southwest Research Institute (SwRI) was contracted under DOD Contract DAAA21-88-R-0021, Delivery Order 004 to perform the following tasks:

1) (3.1) Establish all the requirments necessary for an item to be stored in the general purpose warehouse.

2) (3.2) Determine if nitromethane can be stored in a general purpose warehouse. If nitromethane cannot be stored in the general purpose warehouse, can a waiver be obtained? If a waiver can be obtained, establish what are the conditions that have to be met for storage and who is the cognizant person (names, office symbol, location, and telephone number) that can grant the waiver.

3) (3.3) Determine what is required and if the Army can change the U.S. Department of Defense (DOD) hazard classification of nitromethane to permit storage in the general purpose warehouse, and what procedure and cognizant person (name, office symbol, location and telephone number) will be responsible to grant the change.

4) (3.4) Coordinate and conduct a meeting with all the key players for the DOD and U.S. Department of Transportation (DOT) necessary to attain a unified classification of nitromethane and detail an approach that is required to unify the DOD and DOT classification of nitromethane.

5) (3.5) Address the classification of stearic acid-coated atomized aluminum powder, aluminum slurry, and an aluminum perchlorate solution with respect to the tests, interpretation of test date, and classification of each energetic liquid material. Detailed analyses and all testing to date will have to be provided by the government so this assessment can be made. These topics will be discussed at the meeting with the DOD and DOT personnel.

6) Prepare and present a formal plan for unification of the DOD and DOT classification of nitromethane.

Nitromethane is being considered as a potential candidate for the main energetic material in the Tactical Explosive System (TEXS). A major tactical advantage would be attained if the nitromethane can be stored in Army general purpose warehousing. The program tasks address the requirements necessary for an item to be stored in general purpose warehousing.

The U.S. Department of Defense (DOD) is concerned with classification, storage, and transportation of nitromethane. The U.S. Department of Defense classifies nitromethane as a Group IV, Mass Detonating Liquid Propellant. The DOD classification does not permit nitromethane to be stored in general purpose warehousing. With special storage provisions, nitromethane can be placed in the strong oxidizer category.

The U.S. Department of Transportation (DOT) and the United Nations (UN) are responsible for classification and transportation of nitromethane. The United Nations, U.S. Department of Transportation and Occupational Safety and Health Administration classify nitromethane as a flammable liquid with quantity limitations in packing and transport. This variation in classification is of concern because of the discrepancies in the procedures for transporting and handling of nitromethane and there are other propellant slurry mixtures that are under consideration for TEXS application and their classification will have to be addressed. The Occupational Safety and Health Administration (OSHA) regulates the storage of nitromethane.

In addition, other propellant mixtures/slurries are under consideration for TEXS application. A standardization of procedures for classifying these substances needs to be addressed.

This report presents the results of analysis of these four agencies' policies concerning the transportation, hazard classification or storage of nitromethane. Section 2.0 gives a detailed discussion of the requirements concerning nitromethane by agency. Notes and special provisions are explained in detail. In addition, Section 3.0 discusses the Department of Defense waiver requirements on hazardous substances. Section 4.0 is a synopsis of the minutes of Hazardous Classification meeting held at SwRI. That meeting addressed the concerns, remediations and recommendation of some of the principally involved agencies.

CLASSIFICATION ANALYSIS

The nitromethane hazard classification, transportation, and storage protocols are presented in the following sections.

United Nations

United Nations classifies nitromethane as a flammable liquid, Class 3 hazard with special provision 26. Packing is Group II, Method M.[1] Clarifications to these classifications and provisions are:

- Class 3 hazards are flammable liquids which give off a flammable vapor at temperatures of not more than 60.5°C–closed-cup test or 65.6°C–open cup test.[2]

- Special provision 26 states that this substance has some dangerous explosive properties.[3] These properties are not defined.

- Packing Group II is based on inflammability and initial boiling point with Packing Group II having a flashpoint less than 23°C–closed cup and a initial boiling point greater than 35°C. Nitromethane closed cup flashpoint is 95°F or 35°C with a boiling point of 101.2°C.[4] Packing Group III is for flammable liquids with a flashpoint greater than 23°C and less than or equal to 60.5°C. Nitromethane is listed in Group II because the presence of added substances or impurities cause movement from Group III to II.

- Method M indicates that special recommendations for the transport of the goods by multimodal tank-container. Nitromethane transport in multimodal tanks is forbidden by *Recommendations in the Transport of Dangerous Goods*.[5] Tanks, with a capacity of not less than 450 liters fitted with service and structural equipment necessary for transport of dangerous liquids, are tank containers.[6]

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1. *Recommendations on the Transport of Dangerous Goods*, Chapter 2, p. 45
2. *Recommendations on the Transport of Dangerous Goods*, p. 5
3. *Recommendations on the Transport of Dangerous Goods*, p. 152
4. Rudolf Meyer, *Explosives*, 3rd Edition, p. 246
5. *Recommendations on the Transport of Dangerous Goods*, Table 12.2, p. 324
6. *Recommendations on the Transport of Dangerous Goods*, p. 227

Nitromethane may be shipped in limited quantities which eliminates labeling requirements.[7] Packing in 1-liter metal containers or 1/2 liter in glass or plastic containers is the limit for Class 3, Group II substances.

The United Nations identification number for nitromethane is UN 1261 which is the same as the Department of Transportation.

United Nations hazardous material classification procedures use UN manual ST/SG/AC.10/14, *Recommendations on the Transport of Dangerous Goods, Tests and Criteria.* Flow charts showing the United Nations hazard classification procedures are found in Appendix A.

Department of Defense

The Department of Defense classifies nitromethane[8] as a liquid propellant, mass detonating explosive, Hazard Group IV[5]. Nitromethane falls into compatibility Storage Group F[4]. The following are clarifications:

- Note 4 states nitromethane is chemically compatible with compatibility Storage Group C liquid propellants, but require separate storage due to difference in hazards.

- Note 5 states technical grade or better nitromethane in unit quantities of 55 gallons or less in DOT 17E or C drums may require storage as Hazard Group II provided:

  a) Drums are stacked only one tier high.
  b) Drums are protected from direct sun rays
  c) Maximum storage life of 2 years unless storage life tests show product meets purchase specification at that time. Repeat test at 1-year intervals thereafter.

- The hazards from materials in Hazard Group IV are the same as for mass-detonating explosives. Army Material Command Regulation 385-100 determines quantity-distance requirements.[9]

- Materials in Hazard Group II are strong oxidizers. Army Material Command Regulation 385-100 specifies quantity-distance criteria.[10]

DOD classifies hazards by using the procedures given in Army Technical Bulletin 700-2. Results of these tests determine parameters such as sensitivity to impact, friction, and flashpoint. The parameters from these test require correlation with DOT classification parameters to determine DOT

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7. *Recommendation on the Transport of Dangerous Goods*, Table 15-1, p. 385

8. Army Material Command Regulation 385-100, Table 15-1, p. 15-7

9. Army Material Command Regulation 385-100, Section 15-6(d), Table 15-6, p. 15-3

10. Army Material Command Regulation 385-100, Section 15-6(b), Table 15-3, p. 15-3

hazard classes. The DOT classification determine labeling and packing requirements for transport. Appendix A shows a flowchart of the DOD administration procedures for hazard classification.

Department of Transportation

The Department of Transportation is responsible for the proper classification and regulation of transportation of hazardous substances. Presented are the analysis of the Department of Transportation requirements.

The Department of Transportation classifies nitromethane as a flammable liquid with the following notes:[11]

- Nitromethane identification number is UN 1261. The UN prefix means it is suitable for international shipment.
- Column 5a lists a packing exception number 173.118. Exception number 173.118 is:
  - a) limited quantities become excepted from DOT labeling requirements when packed 1) in metal containers not over 1 quart, packed in strong outside containers, 2) or packed in containers not over 1 pint or 16 ounces by weight each, packed in strong outside containers, 3) or packed in inside containers with a rated capacity of 1 gallon or less, packed in strong outside containers.[12]
  - b) a flammable liquid that does not meet the definition of another hazard class and has a flashpoint of 73°F or higher is not subject to the specification packaging requirements of this part when in packaging of 110 gallons or less.[13]
- Column 5b lists a packing specific requirement 173.149a. Nitromethane requires packing as specified in section 173.119b. Forbidden are shipments in cargo tanks, tank cars, portable tanks or any containers greater than 110 gallon capacity.[14] Section 173.119b covers packing requirements for flammable liquids with a flashpoint of 20°F to 73°F.[15] This section is inconsistent with the flashpoint of nitromethane.
- 1 quart maximum net quantity in one package is the limit for shipping aboard passenger carrying airliners per column 6a.

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11. Code of Federal Regulations, Title 49, Part 172, Table 172.101, p. 142
12. Code of Federal Regulations, Title 49, Part 173.118(a), p. 471
13. Code of Federal Regulations, Title 49, Part 173.118(b), p. 472
14. Code of Federal Regulations, Title 49, Part 173.149a, p. 493
15. Code of Federal Regulations, Title 49, Part 173.119b, p. 475

- 10 gallon maximum net quantity in one package is the limit for cargo aircraft per column 6b.

- Columns 7a and 7b related to water shipments show notes 1 and 2. Notes 1 and 2 stowage on deck or underdeck.[16] Recommended is underdeck stowage.

- DOT has scattered various classification criteria (such as flashpoints for flammable liquids) through out 49 CFR parts 171, 172 and 173. Most of the test use national standards such as American National Standards Institute (ANSI), or American Society for Testing Methods (ASTM), etc. In some cases they require use of test equipment such as a commercial no. 8 blasting cap or Bureau of Explosives' Impact Apparatus.

DOT documentation relates to classification and transportation of hazardous materials. DOT hazard classification procedures are the same as those used by the United Nations. DOT documentation does not address storage.

Occupational Safety and Health Administration

OSHA regulates storage of flammable liquids in industrial/commercial environments.[17] The Army Material Command invokes OSHA requirements as the minimum standard.[18] Addressed in this report are OSHA requirements about container storage because nitromethane transportation is in 55-gallon, DOT-approved drums. Nitromethane transportation and storage in the TEXS context will be in DOT-approved, 55-gallon drums. The following items are a synopsis of the OSHA regulations on flammable liquid storage in containers:

> The definition of flammable liquids are liquids with a flashpoint less than 100° F. These are Class I liquids subdivided into three classes discussed below.[19] The three class subdivisions are:
>
> - Class IA-liquids with flashpoint below 73°F and boiling point below 100°F.
> - Class IB-liquids with flashpoint below 73°F and boiling point above 100°F.
> - Class IC-liquids with flashpoint above 73°F and below 100°F.
>
> OSHA classifies nitromethane as a Class IC flammable liquid using the above criteria.

Flammable or combustible liquids require storage in a tank or in a container that follow paragraph (d)(2). The requirements of paragraph (d)(2) are:

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16. Code of Federal Regulations, Title 49, Part 172.101, p. 77

17. Code of Federal Regulations, Title 29, Part 1910.106 p. 217

18. Army Material Command Regulation 385-100, Section 1-2, p. 1-1

19. Code of Federal Regulations, Title 29, Part 1910.106, Section (19), p. 219

- Any can, barrel, or drum is a container.[20]

- Section (d) says this paragraph applies only to the storage of flammable or combustible liquids in drums or other containers not exceeding 60 gallons individual capacity. This also applies to portable tanks not exceeding 660 gallons individual capacity.[21]

- Section (2) states that:

  - Use only approved containers and portable tanks. Metal containers and portable tanks meeting the requirements of Chapter I, Title 49 of the CFR (that is, DOT approved).

  - Each portable tank require one or more devices installed in the top with enough venting capacity to limit internal pressure under fire exposure conditions.

  - Table H-12[22] list the following container sizes for various types of containers which for a Class IC flammable liquid are:

Glass or approved plastic	1 gallon
Metal (other than DOT drums)	5 gallon
Safety cans	5 gallon
Metal drums (DOT approved)	60 gallon
Approved portable tanks	660 gallons

20. Code of Federal Regulations, Title 29, Part 1910.106, p. 220

21. Code of Federal Regulations, Title 29, Part 1910.106, Section (d), p. 230

22. Code of Federal Regulations, Title 29, Part 1910.106, p. 231

DOD WAIVER REQUIREMENTS

A waiver is granted only after determination that compliance with applicable safety standards is not possible, and that essential work on critical Army material requires performance or other necessary and compelling reasons exist. Waivers and exemptions granted for specific situations and limited as indicated in pertinent correspondence do not cover similar operations, locations, or conditions. Waiver are issued for 1 year or less, and no waiver remains in effect for longer than 5 years. Waivers granted for 1 year require review 1 year from the date of initial request by the installation commander to ensure that the circumstances have not changed. Results of this review and a progress report on milestones completed are forwarded through command channels to the Commander, AMC, ATTN: DRCSF-E. When the time to correct the deviation exceeds 5 years, a request for an exemption is appropriate. Positive steps to program and budget for correction are necessary for granting of waivers.

Facilities in existence or in an advanced state of planning before the issuance of today's standards may not require waivers or exemptions in the following situations provided the current hazard is not greater than that assumed for original use:

1) The facility does not follow present DOD standards as required by Chapter 17 of this regulation; however, the facility is built in accordance with regulations in effect at the time. This also applies to construction plans developed before the effective date of this regulation, can demonstrate that redesign or modification is not feasible, or it is not feasible to reduce quantities of hazardous material.

2) Facilities not following present standards unique to this regulation and the facility and operations have been reviewed and approved by HQ, AMC, ATTN: DRCSF.

Upon local determination that a waiver of mandatory provisions of the regulation is necessary, installations and activities will forward requests through command channels to the Commander, AMC, ATTN: DRCSF. Expiring waivers are not renewed unless there is evidence that all practicable means for following approved standards are exhausted. All requests for exemptions will be forwarded to the Commander, AMC, ATTN: DRCSF-E.[23]

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23. Army Material Command Regulation 385-100, Section 1-6, p. 1-3

LIQUID BLASTING AGENTS AND NITROMETHANE HAZARD CLASSIFICATION MEETING

A meeting hosted by SwRI was held on October 19, 1989 to discuss hazard classification for liquid blasting agents and nitromethane. A list of attendees is presented in Table 1.

TABLE 1. LIST OF ATTENDEES

Name	Affiliation/Address	Phone Number
Robert E. Lyle	Southwest Research Institute	512/522-2170
William R. Herrera	Southwest Research Institute	512/522-3622
William L. Toliver	Southwest Research Institute	512/522-3191
Donna Kessler	AMC Field Safety Activity Attn: AMXOS-SE Charlestown, IN 47111-9669	812/284-7825 AV 366-7825
Earle Smith	HQ: AFISC/SEWV Norton AFB, CA 92409	714/382-3137 AV 876-3137
Edward Klinghoffer	Naval Sea Systems Command Washington, DC 20362	202/692-2080 AV 222-2080
William L. Smith	U.S. Army, PM-MCD	201/724-7933 AV 880-7933
William O. Seals	U.S. Army, ARDEC	201/724-5378 AV 880-5378
Jim Elliott	U.S. Army, ARDEC Attn: SMCAR-SF	201/724-3047 AV 880-3047
Ranen K. Chatterjee	U.S. Army Attn: SMCAR-FSM-M	201/724-6112
Leon Manole	U.S. Army Attn: AMSMC-QAR-R(D)	201/724-5549 AV 880-5549

Mr. Leon Manole of U.S. Army gave a presentation on the Tactical Explosive System (TEXS) to explain its mission and purpose. Mr. Manole briefly introduced the candidate systems and gave a generic discussion of the merits of each. Mr. Manole talked about the Department of Defense classification scheme for liquid propellants and gave the criteria for Hazard Class IV and Hazard Class II. Mr. Manole also discussed the UN and DOT hazard classification criteria.

Mr. William Herrera of SwRI discussed that SwRI will test and evaluate candidate TEXS materials in an unbiased way. The government personnel will be invited to attend testing or review any information from the material testing that SwRI will perform.

The meeting was then turned over to Mr. William Seals of U.S. Army who presented test methods and classification information regarding the liquid propellent program for guns. Particular emphasis was placed on how an interim classification was obtained on these materials. The interim classification was used to allow transport of the gun propellent materials during the research phases. The tests performed for these liquid propellants were:

Interim Classification Tests	Supplemental Tests
Thermal test	JANNAF thermal stability
Card gap	Adiabatic compression
Impact	Critical diameter
Ignition and unconfined burning	Flashpoint minimum pressure for vapor phase ignition
Detonation	Electrostatic sensitivity

Mr. Seals stated that the first two tests are particularly important for liquid propellants. Some of these tests are not mandatory for liquids, but could be imposed, with the first two tests the most serious candidates to be made mandatory. Nitromethane was used as the baseline material for the liquid propellant program because it could be sensitive to adiabatic compression ignition which can cause an explosion or detonation.

Open discussion during this session included the following points:

- DOD is trying to decide which hazard class liquid propellants should be classified. The class candidates are 1.1 through 1.5 which are basically aimed at solid materials.

- Nitromethane should be tested for thermal stability over all temperature ranges to include those below freezing. Nitromethane should also be tested with varying volumes including the test specified 8 cubic inches.

- Jim Elliot of the U.S. Army stated that it seems pertinent to use binary agents in which each binary component is not classified as explosive until the binary agents are mixed at the point of use.

- It was stated that liquid propellants will present a hazard concern during the manufacturing process.

- DOD logistics personnel do not want liquid propellants declassified to lessor hazard classes because it will cause complications in the storage of these materials.

Mr. Seals displayed various viewgraphs showing test apparatus details used in small-scale testing of liquid propellant materials and pointed out specific concerns with testing liquids versus solids with these apparatus. Mr. Manole pointed out there are no available commercial no. 8 blasting caps that meet the specifications. No. 8 caps sold commercially now contain more explosive material and are dimensioned larger than the specification allows. Mr. Manole had to have a commercial firm specially produce no. 8 caps that meet the current specification to perform tests on the TEXS candidates. This manufacturing process took approximately 6 months.

Mr. Herrera presented the next session concerning the criteria for evaluation of liquid blasting agents. Numerous viewgraphs were presented with most paralleling those shown by Mr. Seals in the prior session. Mr. Herrera pointed out what kind of tests can be performed on liquid materials and gave some cautions on this testing. The cautions are:

- Be very careful to test the liquid material without involving effects of the test apparatus itself.

- There are material concerns with liquid materials that are not addressed with the current testing methods regarding solid materials. The test chamber material may have to be coated with a polyethylene liner, for example.

- Have to be particularly careful not to introduce contaminants from the containers.

Another open discussion occurred with the following points discussed:

- DOD has a requirement to transport the TEXS material by the U.S. Air Force Military Airlift Command (MAC). Air Force Regulation 71-4 will be the governing regulation for transport but MAC generally follows the DOT guidelines for hazardous material transport.

- It was pointed out again that there is a lack of adequate test criteria for liquid agents verses solid agents.

- Individual components of the binary agents are safe but when mixed they are now a hazard classified as a mass detonating explosive, Class 1.1.

- A question arose about what happens when binary agents are mixed and placed in the TEXS pipe but not used. Mr. Manole stated that the agents will not be removed from the pipe with the intention of reuse but will be destroyed by explosion or burning when taken out.

- A question arose if nitromethane could be ruled out now because it is not a binary agent.

- Mr. Seals pointed out that small scale testing could be used to preliminarily rank the three TEXS candidates but large scale testing will eventually have to be performed, particularly a critical mass test.

Mr. Herrera led the next session with the topic of generic formulations of the binary candidates. Particular attention was paid to the oxidizer agent of these formulations. Sodium perchlorate is generally used mixed with water to form an aqueous solution of approximately 35 to 50% water. Aqueous sodium perchlorate solutions are considered by the UN and the DOT to be flammable liquids because they may contribute oxygen to a fire if there is a problem. The oxidizing agents cannot be stored with reactive agents and certain metals as a reaction could occur.

Mr. Manole pointed out that the Army stores chemicals such as lye, Draino, soaps, etc., in general purpose warehousing with some of these chemicals being relatively hazardous.

Mr. Herrera presented viewgraphs of the United Nations hazard classification flowcharts for explosives and pointed out that the first question to be answered would be "Is the substance manufactured with the view to producing a practical explosive or pyrotechnic effect?" A no answer leads to certain test sequences. A yes answer leads to more stringent test sequences. Individual components of the binary agent (oxidizer/fuel) are not produced with the intent of producing an explosive or pyrotechnics and therefore can be answered with a no. The binary agents are only intended to be explosive when mixed. Nitromethane is not a binary agent and will be intended to be used as a explosive in the TEXS context and therefore will have to follow the yes path. The consensus of all government meeting attendees was that it would be a valid approach to follow the UN/DOT classification methodology as presented in the flow diagrams.

Another open discussion was pursued to discuss these issues. Those discussed are:

- The DOD Explosives Safety Board will have a meeting October 24 and 25 to discuss the issue of liquid propellant/explosive/blasting agents. It was asked if Mr. Manole could arrange to attend this meeting and Mr. Herrera also. Mr. Manole stated that he would have to have the permission of the PM office but he would try. Mr. Herrera stated he could attend. Mr. Bill Smith of the U.S. Army stated that an outside contractor would have to be invited by the board. Mr. Bill Smith is to check with the board and notify Mr. Herrera by Monday afternoon if he is to attend.

- Mr. Manole stated that the ARDEC Safety Board initially gave the binary candidates an explosive classification until further discussions with the DOD safety community (the reason for this meeting).

- The group looked into DOD classification parameters for sodium perchlorate and determined per AMC 385-100 that there is not a separate classification for sodium perchlorate but just for perchlorates in general. Perchlorates are classified as Class 1.4D if in original container (385-100, page 19-14) and Class 1.3D if not in original container. Class D includes items such as TNT, picric acid, or pentolite. Page 19-19 of 385-100 has perchlorates classified as Group L which includes items such as ammonium nitrate or solid peroxides.

- Mr. Manole stated that the binary agents would be stored in original packaging of DOT specified metal drums. If the safety community desired they would agree to store and transport in stronger drums with increased wall thickness, etc.

- It was stated that there are two ways to approach reclassification. The first would be to ask DOT to change the regulations as specified in Title 49, Code of Federal Regulations which the DOT is usually reluctant to do. The other method is to ask DOT to grant an exemption to these materials which is the usual procedure.

- Mr. Elliott suggested that the PM should state, by letter, that TEXS components are binary with the oxidizer being an aqueous agent which is not addressed in 385-100. Specific labeling and packing requirements should be met. He felt this method would not be challenged.

- Mr. Manole stated that the PM is willing to do any test the safety community desires to be able to qualify the TEXS components for storage in general purpose warehouse.

Mr. William Toliver of SwRI presented the next session. This session was coverage of UN, DOT and DOD hazard classification of nitromethane. Mr. Toliver stated that the UN and DOT procedures are identical. Nitromethane is classified as flammable liquid by both. The UN hazard classification procedure flow diagrams were shown again and it was pointed out that nitromethane is intended to be an explosive substance in the TEXS context and would have to take the YES branch leading to more stringent testing.

Mr. Toliver then presented the DOD classifications for nitromethane which is Hazard Class IV, liquid propellants except that it can be classified in Hazard Class II in the following circumstances:

- Technical grade or better nitromethane in unit quantities of 55 gallons or less stored in DOT 17E or C drums.

- Drums are stored one tier high

- Drums are protected from direct sun rays

- Maximum storage life of 2 years unless storage life tests indicate product meets purchase specification at that time. Such tests are to be repeated at 1-year intervals thereafter.

Mr. Toliver stated that the most important difference between Hazard Group IV and II is the quantity/distance relationships, Hazard Group II having less distance requirements than IV.

Mr. Manole gave some generic facts regarding manufacture, storage, and transportation of nitromethane.

The final session of the meeting was an open discussion of nitromethane. The following items were brought up:

- Mr. Herrera gave short brief on how nitromethane could be tested for the varying effects of nitroparaffin sensitivities.

- Mr. Manole says nitromethane can be made to almost any sensitivity by altering the types and amounts of nitroparaffins.

- Mr. Manole stated that the true tests of an explosive is the substances ability to sustain a detonation wave front throughout the entire medium.

- If a nitromethane specification were to be written for use in TEXS, all nitroparaffins would have to be studies and chacterized for their safety (carcinogentic effects) and performance effects on the nitromethane. The allowable tolerances in the specfication of these nitroparafin would reflect this study.

- Mr. Earle Smith of Norton AFB again stated that the Air Force would prefer the use of the binary candidates.

At the end of this session, Mr. Herrera asked Mr. Manole how to inform the DOT of the results of this meeting. Mr. Manole stated that he would ask the PM office for a decision on the requirements for a briefing to DOT in Washington, D.C.

CONCLUSIONS

Nitromethane is classified as a flammable liquid by the United Nations, Department of Transportation and the Occupational Safety and Health Administration. This classification requires transportation in containers less than 110 gallons. OSHA requires nitromethane storage in DOT-approved containers less than 60 gallons or portable tanks with less than 660 gallon capacity.

DOD classifies nitromethane as a liquid propellant mass detonating substance which invokes quantity/distance requirements. With special storage provisions nitromethane becomes downgraded to less hazardous classes with shorter quantity/distance relationships. This is advantageous to reduce the amount of square footage required for storage. To store nitromethane in general purpose warehousing the Army will have to re-examine the current classification or grant a waiver. Waivers are difficult to obtain and granted on a site by site basis. Waivers are for limited periods not exceeding 5 years. Evaluation is required on a yearly basis. The waiver approach does not seem feasible.

Two alternatives may be preferable to obtaining a DOD waiver. Based on experimental findings, the reclassification of nitromethane to a less hazardous group will allow less stringent storage and handling requirements. The possibility also exists to convert nitromethane to a binary system, whereby each of the constituents is classified within a less hazardous grouping, and hazardous characteristics are only in evidence at the end use application. This approach would also be feasible for other candidate propellant slurry/mixtures. Further study will be necessary to optimize either of the alternatives.

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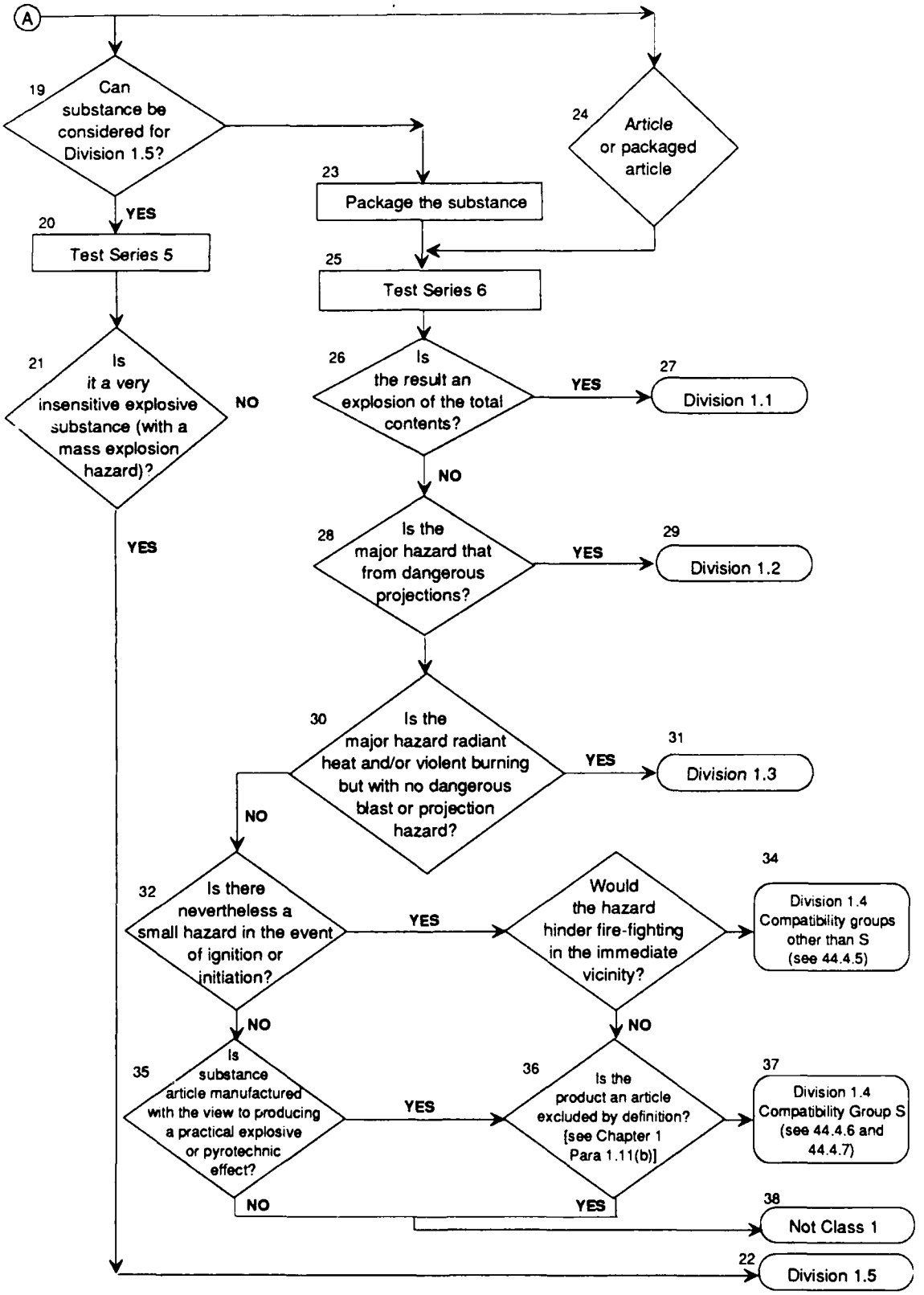
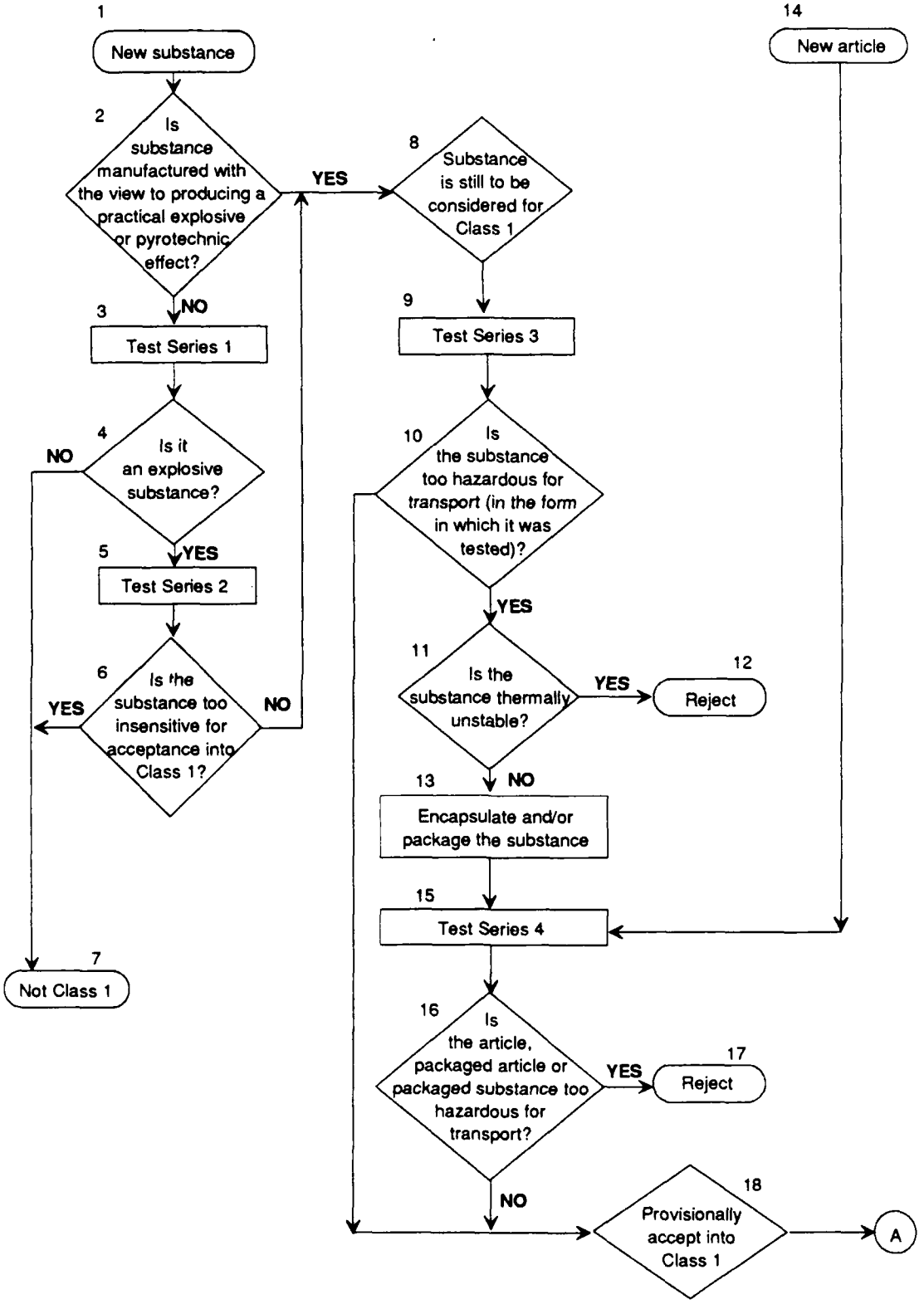
APPENDIX A

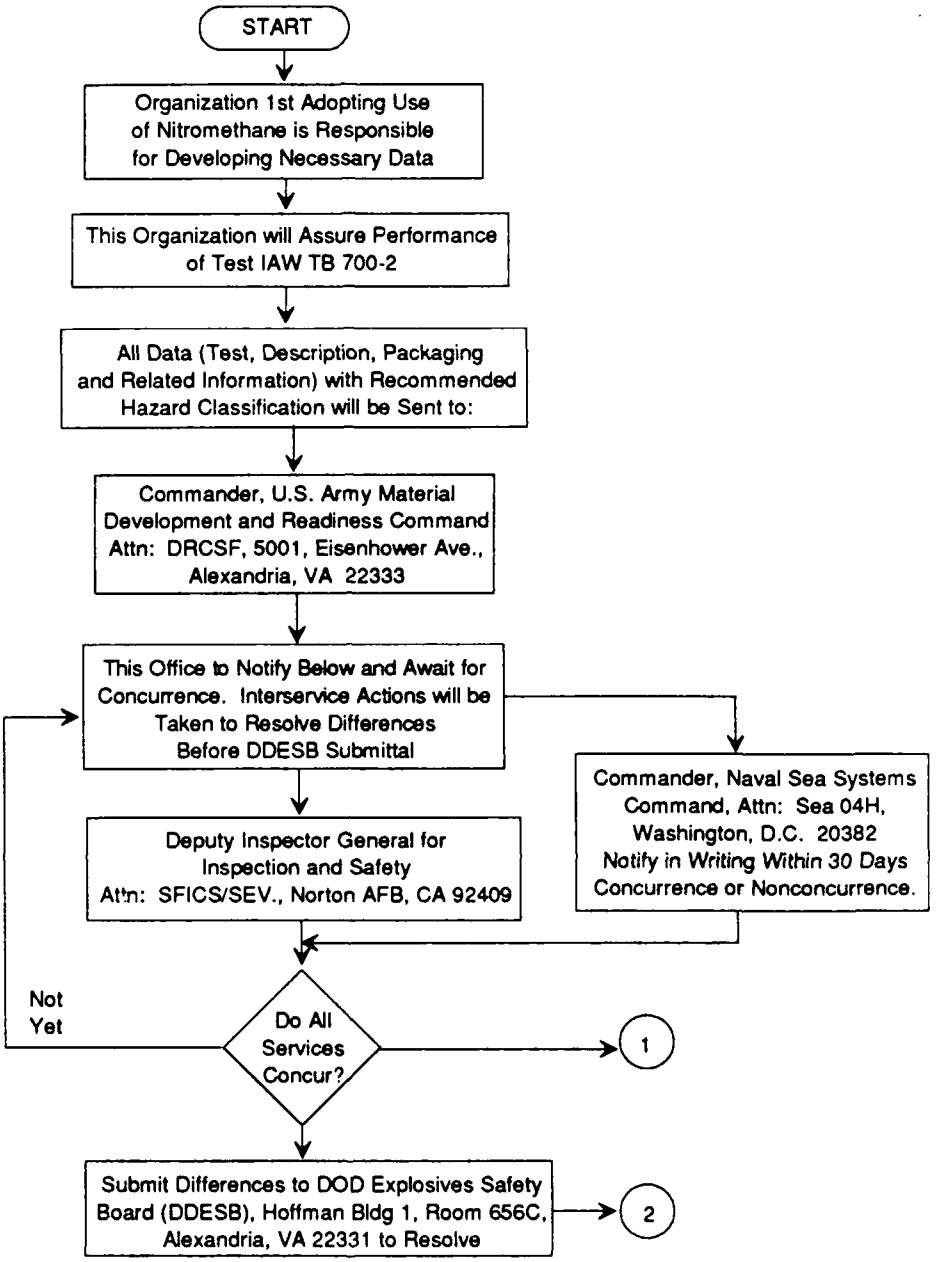
UNITED NATIONS PROCEDURE FOR ASSIGNMENT OF HAZARD DIVISION



UNITED NATIONS HAZARDOUS SUBSTANCE ACCEPTANCE PROCEDURE



DOD ADMINISTRATIVE PROCEDURE FOR HAZARD CLASSIFICATION



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